



Review

Pink tooth phenomenon: An enigma?

Raveena Thapar, MDS Assistant Professor^{a,*},Swati Choudhry, MDS Post-graduate Student^a, Anju Sinha, MDS Assistant Professor^a,Ruchita Bali, MDS Assistant Professor^a, Deepika Shukla, BDS Assistant Professor^b^a Department of Oral Pathology, SBB Dental College, Ghaziabad, India^b Department of Oral Pathology, Babu Banarsi Das Dental College, Lucknow, India

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ABSTRACT

Background: The appearance of pink teeth is a common phenomenon which has been observed after death in certain circumstances on post-mortem examination. Extra fibrinolytic activity of pulp facilitates rapid breakdown of red blood cells and diffusion of hemoglobin and its derivatives to flow into dentine. **Methods and results:** We reviewed various studies on pink tooth phenomenon which have stated the various factors that lead to pink tooth formation. Most of the authors have stressed that post-mortem pink teeth must not be considered as a reliable odontological parameter for determining cause of death. **Conclusion:** No correlation has been found between the occurrence of pink teeth and the cause of death but condition of the surroundings certainly plays an important role in the development of this phenomenon. This paper reviews the factors and conditions responsible for formation of pink teeth.

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1. Introduction

The phenomenon of 'pink teeth' was first described by Thomas Bell as the osseous part of the tooth being colored red, whilst the enamel was unaffected.¹ It has been stressed that pink tooth must not be considered as a reliable odontological parameter for determining the cause of death² but various studies^{3–5} have shown that this phenomenon is a common finding related to cases of asphyxia such as strangulation, drowning or suffocation. However, this phenomenon could also occur in living subjects most frequently associated with infectious diseases e.g. typhoid fever and in endodontically treated teeth.⁶ Miles et al. also stated that a moist environment is essential for the development of pink teeth.³ It was suggested that this pinkness is a natural phenomenon caused by seepage into the dentinal tubules of a fluid containing hemoglobin or its degradation products derived from decomposition or liquefaction of the tooth pulp.⁷ It seems probable that coloration of the teeth would be found in those regions of the jaws where the blood is seeping on the basis of gravitation hypostasis.⁸ The phenomenon was more pronounced in younger individuals due to age-related changes of the root canal, less penetrable by the pigment responsible for the post-mortem pink staining.⁹ Incisors, canines and premolars seem to stain more intensely than other kinds of teeth.

Decayed teeth don't stain as quickly as healthy teeth, due to an initial reduction in pulpal volume and subsequent reduced amount of blood in the pulp chamber.⁷ Another reason for this could be due to presence of sclerosed or secondary dentine to be impenetrable to hemoglobin and thus escaped the pink pigmentation.¹⁰

2. Etiopathogenesis of pink teeth

The post-mortem finding of pink teeth is a pathologic sign that remains may have been in a specific environment for a prolonged duration.⁹ Pink tooth phenomenon depends on special anatomical features such as the existence of porous structures protected by a dense material, therefore explaining the existence of pink teeth.¹ Various biochemical investigations like spectral studies, isoelectric focusing, carbon monoxide detection were performed to detect the cause of this pink phenomenon. Spectral studies strongly indicated the presence of hemoglobin derivatives in the pulp of pink teeth, probably saturated with carbon dioxide, due to lack of oxygen post-mortem.⁵

Histological identification for the causative pigment was performed by Van Wyk who suggested that the dentinal tubules played a vital role in pigmentation formation, larger their diameter greater were the chances of pigmentation of dentine. He also found that haem group of pigments that relate to the phenomenon of post-mortem pink teeth are hemoglobin, the porphyrins, hemosiderins, bile and its related pigments.¹⁰

* Corresponding author. Tel.: +91 9015844476.

E-mail address: koolravs83@gmail.com (R. Thapar).

The presence of increased amounts of iron in pink dentine over normal dentine, presumably from hemoglobin and its decay products has been confirmed by Ikeda et al. using semi-quantitative EDAX analysis.¹¹

It seems that this phenomenon is more dependent on physical than chemical factors after death.¹² Studies also report that the pink coloration of teeth may occur more easily in the teeth in which dentin is less compact and contains more dentinal tubules.^{1,13} Pink teeth have also been described in the archeological science literature where a clear difference has been shown on the basis of external appearance between the archeological pink teeth and those described as pink teeth in forensic literature. Archeological samples did not show any external signs of pink dentine. It is reported that pink pigmentation in ancient teeth is a consequence of post-mortem decay factors, particularly caused by the tunneling hyphae of various species of saprophytic fungi.¹⁴

3. Location of pink color in teeth in various conditions

Descriptions of pink teeth appearing in forensic literature have several points in common among them.¹⁵ The red pink discoloration of teeth roots get particularly deep towards the cemento-enamel junction, fading off, but still visible beneath the enamel.^{1,4,5}

Miles et al. 1953 gave a description of two individuals, one who had drowned and the other who was buried alive. He noticed that the crowns of teeth were pink and this discoloration extended apically with declining intensity and seemed to be more of a patchy distribution in the roots.³

Van Vyk in 1987 observed presence of pink coloration in all teeth, surrounding alveolar bone and gingivae in those who had drowned.⁴ Both Miles et al. and Van Vyk also commented upon the variability between even the adjacent teeth within the same jaw, some displaying marked pinkness while the others being relatively unaffected.^{3,4,10}

4. Progressive histological changes in formation of a pink tooth

Sainio et al. in 1990 performed a study on young and old wistar rats. This study gives a clear description of the mechanisms associated with pink teeth formation. Five groups of animals were studied, totally fifteen rats. The groups were autopsied 0, 24, 36, 42 and 58 h after death. The first group made the control series. The animals were kept at room temperature and pressure after death. The animals were also placed in different positions to study the dependant lividity.¹² Table 1 highlights the histological changes observed at each time interval.

5. Discussion

Although the phenomenon of pink teeth has been known since 1829, its application in Forensic Dentistry has been limited.² The incidence of pink teeth in people who died by asphyxia seems to be greater than in other forms of unnatural death, may be due to extravasation of blood caused by a rapid rise in venous pressure.¹⁷

Forensic Odontologists attest that pink teeth are not uncommon in bodies investigated for cause of death.¹⁸ Following death, and with time and suitable conditions, dental pulp tissue may undergo autolysis in which hemoglobin is freed from erythrocytes and maintained in solution. Such hemoglobin diffuses into the dentin through the dentinal tubules.⁷

Whittaker et al. in 1976 studied a group of golden hamsters, half of the group being strangled, the other half given a barbiturate overdose. Half of each group was placed in soil and the other half in seawater. The onset of pink pigmentation was observed between

Table 1

Time related post-mortem histological changes in formation of a pink tooth.

Time interval	Histological changes
Immediately after death	<ul style="list-style-type: none"> • Marked vasodilation in pulp, PDL, alveolar bone • Hyperemia in radicular pulp than the coronal part
24 h after death	<ul style="list-style-type: none"> • Dilated blood vessels • Autolysis of red blood cells, but no aspiration seen into the dentinal tubules • Pulpal edema
36 h after death	<ul style="list-style-type: none"> • Emptied vessels in alveolar bone and PDL • Extravasation of erythrocytes from capillaries • Increased edema and vacuolization
42 h after death	<ul style="list-style-type: none"> • Widely dilated blood vessels • Extravasated erythrocytes predominantly in coronal pulp
48 h after death	<ul style="list-style-type: none"> • Emptied blood vessels in PDL and alveolar bone • No evidence of hard tissue formation

2 and 3 months later and came out faster and more intensely in strangled animals. Animals buried in soil developed pink teeth slower than the others.¹⁶

In a similar study done by Brondum and Simonsen in 1987, it was observed that the pink teeth occurred in 26 forensic cases out of 119 where 21 were those whose bodies were recovered from seawater, 3 were found hanging and other 2 were poisoned.¹⁹

Van Vyk also commented upon the frequency of pink teeth in forensic cases. Among 200 corpses examined between 1985 and 1989, 21 displayed pink teeth where 9 were drowned at sea, 3 were stabbed to death, 4 died due to petrol filled tyre placed around their necks.^{4,10,20} Another study reported an advanced decomposition of a female corpse with pink teeth formation. A combination of intoxication, hypothermia and pneumonia could be established as a cause of death.¹

Beely and Harvey in 1973 reported the pink teeth phenomenon in 5 cases after death. One subject who was a 31-year-old woman had died due to barbiturate poisoning. The second case was a 40-year-old man who had been shot then buried and was found 96 days after death. The others were the subjects who had drowned and then discovered 30, 35 and 90 days after death.⁵

Almost all authors in various studies have reported moist environment to be the commonest cause for the occurrence of pink teeth.^{5,7,9,16,19} It was observed that humidification was an important requisite for the pink tooth phenomenon required to keep the pulp protein solubilized so that diffusion can occur into the dentin.⁵ Takahashi and Williams suggest that the rate of hemolysis is at a maximum temperature of less than 10 °C, which could explain the increase in the rate seen in cold conditions such as at sea.²¹

A study was conducted by Van Vyk in 1989 to produce pink teeth with cadaveric blood and to correlate the time sequence of the coloration with the pattern of hemolysis of blood. It was concluded that pink staining of teeth can only occur after hemolysis and that discoloration becomes obvious macroscopically at about 6 days.¹⁰

Sainio et al. also conducted a study on rats and suggested the mechanisms associated with pink teeth formation. The time delay observed between death and red blood products getting into the dentine may be explained by the fact that erythrocytes average 7.5 microns in diameter whilst dentinal tubules are only 3 microns in diameter so pink dentine can only occur after the breakdown of erythrocyte cell walls to allow hemoglobin and breakdown products to filter into dentin.¹⁰

6. Conclusion

The forensic literature reports that the post-mortem pink tooth phenomenon has been reported in cases of physical trauma,

drowning, strangulation, barbiturate poisoning and sudden or unnatural death. Due to difference in the conditions in which pink teeth have been reported, it may be concluded that they are not pathognomic for a specific cause of death but a significant association has been seen between asphyxia and pink teeth than in other unnatural forms of death. Further studies are required to elucidate its role as a post-mortem finding. Also, studies can be performed to establish the time of death using this pink tooth phenomenon.

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Conflict of interest

None declared.

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